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THE SCHOOL OF PYTHAGORAS.

Le Scuole Ionica, Pythagorica ed Eleata (I Pre-aristotelici, I.) By Dr. Aldo Mieli. Pp. xvi + 503. (Firenze: Libreria della Voce, 1916.) Price lire 12.

THAT the study of history maketh a man wise was the saying of a great Elizabethan, but it was one of the great Victorians who preferred a copy of the *Times* to "all the writings of Thucydides"; the great days of Elizabeth would not seem so spacious had one or two such sayings as the last come down to us from them! An historic sense was somewhat far to seek in the Victorian age. The nineteenth century had all but forgotten its own past. Lyell and Darwin, Schwann and Virchow, Lister, Faraday and Joule had a way of making their immediate predecessors look old-fashioned, as the post-chaise looked when the railway came. In short, so great a revolution had taken place in things mental as well as in things practical that it seemed (so Judge Stallo said) as though Bacon's demand had at last been thoroughly complied with, *ut opus mentis universum de integro resumatur.*

I never heard a lesson in my school- or college-days on the historical aspect of any science, though some few of our teachers were by no means unacquainted with history. One was on intimate terms with Ray and Willughby, and all the older English naturalists; another got no small part of his large wisdom from Boerhaave and Haller, and even Ambroise Paré. There was yet another who led his pupils (his better pupils) to Newton, while his neighbours were perfectly satisfied with Frost. When one thinks how deep was the reading, how wide the learning, of men like Sharpey and Rolleston, Alfred Newton and Michael Foster, it is all the more striking that even by them the historical method was very seldom employed and the love of history very little instilled. The fact is, we were all dazzled and obsessed, young and old, by "the great press of novelty at hand." Linnæus and Cuvier, even Johannes Müller himself, had read their Aristotle to learn of him, just as they read their Swammerdam and their Réaumur. But we had come to think of the old books as so much bric-à-brac, as material for a hobby but of no more use in the world. The tide has turned since those days, one scarce knows how or why; and a world that is as busy as ever finds more time for the study of history than it did. The long series of Ostwald's "Wissenschaftliche Klassiker" is proof of a widespread desire to consult the sources of knowledge; and Mach's "Science of Mechanics" is perhaps the best but not the only example of the historic method, rigorously and critically applied to the teaching of a science.

Dr. Aldo Mieli, the writer of the book before us, is already known by a number of historical articles in *Scientia,* that admirable journal of our Italian allies; we may welcome him accordingly as a member of the little company of historical students, of which Prof. Gino Loria is the distinguished head. He all but takes our breath away, in his very preface, by the vastness of his conceptions and his projects, while he relates with ingenuous sincerity the recent history of his own mental development. He had a thirst for universal knowledge in his schooldays, and essayed to comprehend, "con l'aiuto di poche premisse, tutti i fenomeni fisici e sociali, artistici e filosofici." He presently sought in mathematics, but sought in vain, for the inner meaning, "la spiegazione," of things. When he failed there, he betook himself in haste to chemistry; "a corpo perduto mi gettai allora (1902) nello studio della chimica!" He was baffled again; he had striven as the old alchemists strove, and his longings, like theirs, were unfulfilled. At last, under the influence of Mach and Ostwald, he turned to history and to philosophy; renouncing the search after a "rational and experimental explanation of the world," he resolved to study the creations of the spirit, and to trace in particular the development of scientific thought.

While charmed by these naïve confessions of the young Italian scholar, the reader is startled to discover that the present bulky book is but the first part of a universal history, on a scale vaster than Gibbon's or Hallam's, of the whole circle of the sciences. It is to be divided into some seven portions, dealing with the great ancient pre-Hellenic empires, next with Hellenic, Arabic, and Far-Eastern science; again, with the Middle Ages and with the Renaissance to Galileo's day; and lastly, with the seventeenth and eighteenth centuries. The story of Hellenic learning will be divided into four parts, of which one must end where Aristotle's work begins; and this pre-Aristotelian treatise will be in three volumes, of which one is the book before us, and the other two will deal in due time with the Atomists and with Plato and the Sophists.

The reader may be a trifle prejudiced, he might be dismayed or even dumfounded, by so vast an ambition. But the fact is that the book is marvellously well done—so far as the present writer is capable of judging. Big as it is, it is compact and full; it leads us smoothly and easily, with but brief and impartial discussion, through the subjects on which we expect and desire to be informed. We hear the legendary history of Pythagoras and his confraternity; we are introduced to the philosophy, the science, and the mystical mathematics of the school. We learn in successive chapters, for instance, of the mystical theory of number; of figurate and other curious numbers, and of the *proportio divina*; of the great Pythagorean theorem, and of the gnomon; of the concepts of application and of excess and defect; of the principles of acoustics and of the musical scale, and of the astronomic and other theories of Archytas and Philolaus and the rest. The subjects are those with which any book or encyclopædia article on Pythagoras is bound to deal, and there is little here but what we can get from others. But here it is, well and clearly ordered and expressed, and abundantly furnished with all sorts of guide-posts for those in quest of still more information or discussion.

The bibliographical lists are astonishingly good, without pretending to "completeness." The one, for instance, which is appended to the first section of our volume is of a general kind, and covers some seventy pages; it pilots the student to the texts of Diels, Mullach, and others; to works on the history of philosophy, Greek and other, from the days of Ritter and Preller to Zeller and Burnet and Diels; and ends with a capital account of the historians of mathematical, astronomical, and physical science, from Bailly, Montucla, and Delambre, to Allman and Zeuthen, and Moritz Cantor and Paul Tannery and Sir Thomas Heath. There may be mistakes, for aught I know, in this learned and compendious book, but I have neither found them nor sought for them. It was one of Pythagoras's sayings (or Dr. Johnson tells us so) that a friend should not be chidden for little faults.

Pythagoras is one of the great figures of the world, and many and many a scholar has had a predilection for him. Sir Thomas Browne loved him; Plato was steeped in his doctrine; and whole books of Euclid are ascribed to his teaching. Those who knew least of him could always quote him, as Shakespeare did, and Dr. Johnson, and as Goldsmith quoted Ocellus Lucanus. But the more we read about Pythagoras the less we know of him for sure and certain; and it is just herein that his peculiar fascination lies. For he is one of those shadowy figures who stand on the borderland between history and fable, between fairyland and reality: like King Arthur and Thomas of Ercildoune and King Solomon and Caliph Haroun al Raschid. We know that one of his legs was of gold, that Apollo was his father, that heavenly messengers flew down to him on golden arrows, and that his face shone like the faces of the Shining Ones. In more sober statement he seems to represent the continuity, unbroken but dwindled to a thread (a thin but indispensable thread), between one civilisation and another, between the beginning of Greek thought and the decline of learning in a remote but erudite antiquity. To the student trying to prefigure so strange and so elusive a personality there is a choice of ways. If he keep to sober and critical consideration of the meagre facts at hand, he will probably arrive at the conclusion that there is no evidence for Pythagoras having learned anything worth speaking of upon his travels or having inherited any load of learning from pre-Hellenic science and philosophy. So it is commonly held by many men of the soundest classical learning that no foreign influence can be traced in the school of Pythagoras, and that his "philosophy and institutions contain nothing but what might easily have been developed by a Greek mind exposed to the ordinary influences of the age." Dr. Allman held, with all due caution, that we must be "struck with the Egyptian character of the geometrical work attributed to Pythagoras"; but Prof. Burnet asserts that all the mathematics of the Egyptians consisted of a few rules of thumb by which to measure the area of a field or the height of a pyramid, and denies that Egypt had anything to teach Pythagoras that was worth the learning or the borrowing.

On the other hand, there is ample room for others, of a more imaginative disposition, to grope among the ruins and the misty darkness of pre-Hellenic civilisation, to put two and two together wheresoever they can, and to apply themselves (for a while at least) to the ingenious art of fanciful reconstruction. Dr. Naber's curious book, "Das Theorem des Pythagoras," is of the latter kind. The ground on which he leads us is sometimes dangerous, as when he depends on Piazzi Smyth for his facts as well as his theories of the pyramid; but for all that he weaves a fascinating and instructive story. He brings together a prodigious mass of curious lore about the triangle and the pentagon, and the Sacred Letter, and the Symbol of Health, and Abracadabra, and the sacred lotus and mallow-flower; he touches on a hundred things which the early students of the triangle must (in all likelihood) have observed and discovered by the way; and he suggests with no less ingenuity the lines of tradition along which such knowledge ran, from far-away antiquity even to the artists and cathedral-builders of the Middle Ages.

If we be inclined to see in Pythagorean mathematics not the discoveries of a single lifetime but fragments of the learning of a preceding age, so also in his philosophy may we be inclined to recognise parts of a great edifice the scattered stones of which confront us in unexpected places, built into the fabric of old but less ancient walls. We have often heard that there is a curious link or bond between the Cabbalists and the Pythagoreans; and now again, in a recent *Hibbert Journal*, an article by the Chief Rabbi on "Jewish Mysticism" suggests, though it does not assert, this view. The "opinion of Pythagoras" regarding metempsychosis, wholly absent from Bible and from Talmud, is fundamental to the teaching of the Cabbala. In Cabbalistic as in Pythagorean philosophy the ten numerals, or Sefiroth, contain the possibilities of all things, and, with the help of language, represent the Spirit of God; the mystical number Ten is the material universe, God's kingdom made visible; wisdom and understanding, mercy and justice and harmony are among the concepts which other numbers represent or embody; and the mystical One is the mystery of mysteries, which in the beginning filled all space and was all space. Then "En Sof contracted Himself in order to leave an empty space for creatures"; just as, according to Pythagoras, *ἐπεισάγεσθαι δ' ἐκ τοῦ ἀπείρου χρόνον τε καὶ πνόην καὶ τὸ κενόν.* The Pythagorean, or Platonic, or Jewish concept of Number is a hard saying to the unpoetic, non-mystical modern and Western world; and many a way is found to show that Plato and Pythagoras meant something prosy and commonplace after all. But to some it is still as plain as ever that Number is the clue to the greatest of earthly mysteries, and that what we call beauty, whether of sound or form, is but its resultant and expression. It was in the very spirit of Pythagorean mysticism and wisdom that that great naturalist, Henri Fabre, wrote his great ode to number; as in a kindred spirit the old carpenter in Verhaeren's poem:

> "Fait des cercles et des carrés,
> Tenacement pour démontrer
> Comment l'âme doit concevoir
> Les lois indubitables et fécondes
> Qui sont la règle et la clarté du monde."

We must never forget that the secrets of the mystic, whether Gnostic, Cabbalist or Pythagorean, lie very deep indeed, and that a twin alternative between esoteric and exoteric statement, or between literal and allegoric interpretation, by no means exhausts the various meanings which the mystical philosopher can wrap up in his words. In the end, as we come slowly to a better, though still a clouded, understanding of what lies within and behind the Golden Verses and all the rest of the husk of Pythagorean tradition, we feel the truth and force of William James's saying (aptly quoted in the article to which I have just referred), that the "mystical classics have neither birthday nor native land; their speech antedates language, and they do not grow old."

D'ARCY W. THOMPSON.

PHYSIOLOGICAL CHEMISTRY.

Physiological Chemistry: A Text-book and Manual for Students. By Prof. A. P. Mathews. Pp. vii + 1040. (London: Baillière, Tindall and Cox, 1916.) Price 21*s.* net.

PROF. MATHEWS is well known as a worker in the field of physiological chemistry, more especially on its physical side. His present volume is one of an ambitious character, and has the merit of being distinctly original. The chapters on the chemistry of the fats, carbohydrates, and proteins are fuller than is usual in such books, and the subject-matter is not only clearly explained, but is fully up to date. Much of it is pure chemistry, but it will not be less valuable for that reason to the biologist. The section on physical chemistry is also treated at considerable length, as might have been anticipated by those who know the author's bent. The whole subject is confessedly treated unequally, for, as the preface puts it: "Of so large a subject one can be personally familiar with but a small part." The portions that strike one as susceptible of more expansion are those dealing with muscle and the ductless glands; for the latter group of organs Prof. Mathews coins yet another name: he dubs them the Cryptorhetic Organs—*i.e.* organs with a hidden flow. One small feature of the book—viz. the explanation and derivation of technical terms—might well be imitated in more elementary manuals than the present. While on the question of words, one may add that the nomenclature adopted for the fats and fat-like substances is one not likely to commend itself to all physiologists.

Each chapter is followed by a short selected list of papers bearing on the subject dealt with in that chapter. There is no attempt at a complete bibliography, but the selections appear to have been judiciously made, though in the present state of the political atmosphere German writers figure rather too largely for English taste. The papers mentioned for reading and study are mostly recent ones, because they approach the subject from the modern point of view, and in them the older literature is cited. The choice does not imply that the author does not value the work of the early pioneers; indeed, he presents evidence that he takes the opposite point of view, and the full consideration which he gives to their work forms one of the most interesting features of his book. He, for instance, gives a very extensive account of the researches of Lavoisier, whom he perhaps rightly regards as the founder of bio-chemistry, of Beaumont, of Claude Bernard, and many others.

Prof. Mathews, who is here the exponent of a vast but nevertheless comparatively young branch of science which every day is becoming more and more exact, is not devoid of a sense of imagination, the most valuable asset of both a teacher and a researcher. His excursions into the regions of speculation will be read with keen interest, even although, like so many hypotheses in the past, they may ultimately be forgotten. Such theories as those which he advances in his comparison of the animal body to a magnet, or in his conception of the "conservation of psychism," or in his attempts to explain memory on a chemical basis, will certainly stimulate thought and future investigation. To quote once more from the preface: "It is hoped that this book will raise in the mind of those who read it more questions than it answers."

The last 160 pages of the book are devoted to a description of the laboratory work in physiological chemistry as carried out in the University of Chicago, and practical teachers will obtain many useful wrinkles by studying these. W. D. H.

OUR BOOKSHELF.

Cambridge Geological Series. Agricultural Geology. By R. H. Rastall. Pp. ix + 331. (Cambridge: At the University Press, 1916.) Price 10*s.* 6*d.* net.

MR. RASTALL'S well-written and excellently printed book is a treatise on geology for agricultural students rather than on agricultural geology. To say this is no disparagement, since it is obviously intended for the stage in an agricultural curriculum when natural history subjects are predominant, and not for the later years when preliminary scientific conceptions are applied to the study of the soil. A knowledge of chemistry and elementary mineralogy is presupposed, but unnecessary technical terms are carefully excluded. The final chapter, on "The Geological History of the Domestic Animals," will appeal especially to those whose work is on the farm. The history of life on the globe is, indeed, far more appreciated by agricultural scholars than